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ORIGIN

OF THE

EPIGASTRIC AND OBTURATOR ARTERIES

BY A

COMMON TRUNK FROM THE INTERNAL ILIAC ;

WITH

AN INQUIRY INTO THE AMOUNT OF DANGER OCCASIONED BY  
VARIOUS POSITIONS OF ARTERIES IN THE ORDINARY  
OPERATIONS FOR FEMORAL AND  
INGUINAL HERNIA.

BY

P. REDFERN, M.D., LONDON,

LECTURER ON ANATOMY AND PHYSIOLOGY, AND ON HISTOLOGY, AT THE UNIVERSITY  
AND KING'S COLLEGE, ABERDEEN.

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M D C C C L.

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## ORIGIN

OF

### THE EPIGASTRIC AND OBTURATOR ARTERIES.

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IN the summer of the year 1849, I met with the following very unusual case of origin of the epigastric and obturator arteries from the internal iliac, in a male adult æt. 27, five feet eleven inches in height, who died of hæmoptysis from tubercular deposition, and was brought to the anatomical rooms. The arrangement of all the large vessels was carefully examined, and a drawing, from which the accompanying woodcut has been executed, was made at the time, the preparation being also preserved.

*Arrangement of the vessels.*—The abdominal aorta divides in the usual manner, on the left side of the fourth lumbar vertebra, into the two common iliac trunks. Of these, the left one was cut away in a *post-mortem* examination made before the body came into my possession; the right terminates by division into an external and internal iliac artery at the sacro-iliac synchondrosis, and is an inch and three-quarters long.

The external iliac artery follows its usual course, and has its ordinary relations. It is  $3\frac{1}{6}$  inches long, and gives off from its outer side, immediately under Poupart's ligament, the circumflex iliac artery of its usual size, and having its customary course and distri-

bution. The inner side of the external iliac, quite close to Poupart's ligament, furnishes a branch,  $\frac{1}{24}$ th of an inch in diameter, which, inclining inwards over the external iliac vein, meets with the spermatic cord, and ramifies upon it in the inguinal canal, thus representing the cremasteric branch of the epigastric artery. All the small vessels are well filled with ordinary injection, but no communication of the cremasteric branch, nor of the external iliac trunk, with the epigastric artery, can be found.

The internal iliac artery runs downwards without giving off any branch for  $1\frac{2}{3}$ d inch, reaching nearly to the upper edge of the sacro-sciatic notch. It then furnishes the following branches:—

1st, From its right side and in front, a common trunk for the epigastric and obturator arteries, or an epigastric artery which furnishes the obturator in its course.

2d, From its posterior part, an ilio-lumbar artery of large size.

3d, From the front of the artery, a little lower down, a common trunk for the partially obliterated hypogastric, the pudic, and middle hæmorrhoidal arteries, with a small vessel, which runs out of the pelvis at the upper part of the sacro-sciatic notch, giving off a small branch, which runs forwards on the surface of the obturator-internus muscle, and divides into two branches, the higher of which is not far from the usual position of the obturator artery, and anastomoses by small branches, with a descending branch of the obturator given off close to the obturator-foramen; whilst the lower division runs downwards and forwards to anastomose with a branch ascending from the pudic to join with the small descending branch of the obturator.

4th, The internal iliac gives off a small vessel, which passes obliquely upwards and outwards over the brim of the pelvis into the substance of the iliacus muscle, and anastomoses in it with the ilio-lumbar artery.

5th and 6th, Two lateral sacral arteries pass off from the posterior part of the iliac, the higher in position entering the first anterior sacral foramen; the other inclining downwards, and furnishing branches which pass into the other sacral foramina.

7th, The internal iliac divides, at the distance of  $2\frac{1}{2}$  inches from its origin, into the gluteal and ischiadic arteries; the gluteal passing between the lumbo-sacral and the first sacral nerves, and escaping from the pelvis at the upper part of the sacro-sciatic notch, breaks up into branches at  $1\frac{2}{3}$ d inch distant from its origin; the ischiadic passing between the first and second sacral nerves, leaves the pelvis below the pyriformis muscle, and has its usual distribution.

The common trunk of the obturator and epigastric arteries, arising from the internal iliac very near the ordinary point of origin of the obturator, is  $2\frac{1}{2}$ th inches in length, and  $\frac{2}{15}$ ths of an inch in diameter. From its direction, it appears to be epigastric rather than obturator, for it follows almost a direct course, curving only very slightly downwards, in its passage to the crural ring, at which point it turns upwards, in the wall of the abdomen, like the ordinary epigastric. In its course along the side of the pelvis, the common trunk crosses obliquely over the small fourth branch of the internal iliac, then at an angle of  $40^\circ$  over the obturator nerve, and at its division it lies an inch above the obturator vein, which passes backwards from the obturator foramen to the internal iliac vein. After giving off the obturator artery at  $2\frac{1}{2}$ th inches distant from the internal iliac, the trunk continues in its original direction, very slightly diminished in size, and becomes the epigastric artery. This vessel crosses the centre of the crural ring at  $\frac{1}{3}$ d of an inch distant from the external iliac vein, and, applying itself to the posterior boundary of the inguinal canal, close to the inner edge of the internal abdominal ring, it has the vas deferens hooked round its outer side, and the spermatic cord, with the cremasteric branch of the external iliac artery, in front. At the distance of half-an-inch beyond the origin of the obturator artery, a small branch comes from the epigastric, passing through the crural ring, and terminating by ramifications on the surface of the pectineus muscle. A sixth of an inch further on, the epigastric furnishes another small branch, which is ramified on the posterior surface of the pubes, and at  $1\frac{1}{3}$ d inch from the origin of the obturator, the course of the epigastric is crossed by Poupart's ligament.

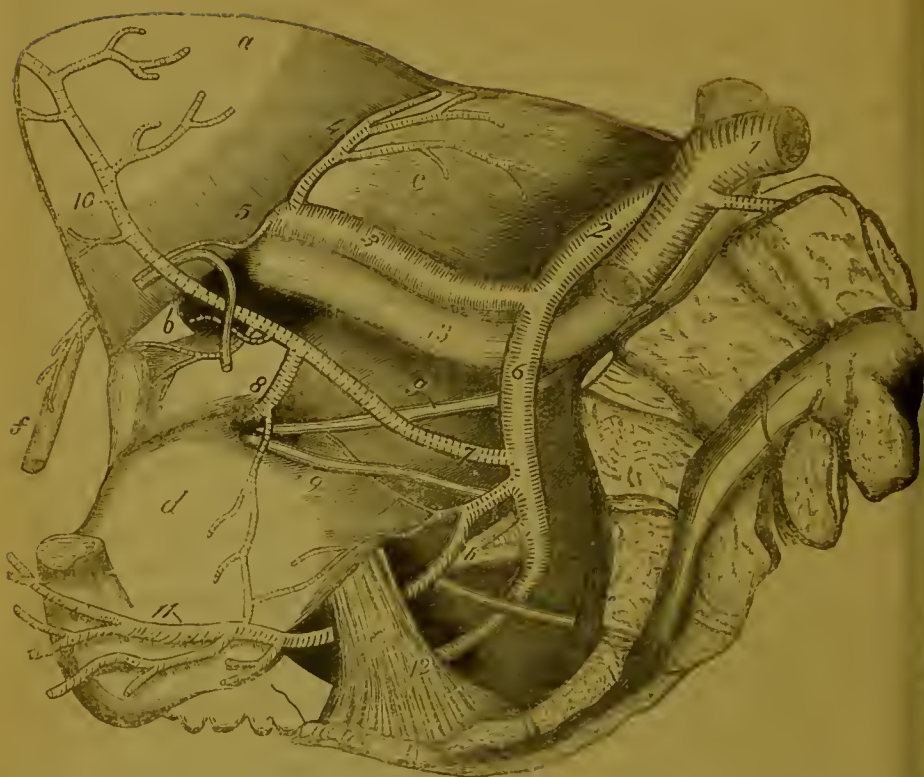
The epigastric artery is accompanied by two veins as far as Poupart's ligament, when one opens into the external iliac vein; the other is joined in front of the artery by two small veins which come from the posterior surface of the pubes, and run directly across the crural ring,—the vein, formed by the junction, opening also into the external iliac quite close to the other epigastric vein.

The obturator artery, of the same size as the epigastric, passes off from the common trunk exactly at a right angle, and, inclining downwards and inwards for an extent of an inch, it joins the nerve and vein at the sub-pubic canal, through which all these parts then pass in the usual manner. Before entering the canal, the artery gives off a small branch which runs a straight course upon the obturator muscle to join with an ascending branch of the pudic, this anastomosis receiving also the small branches which run downwards and forwards from the internal iliac trunk.<sup>1</sup>

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<sup>1</sup> A few irregularities of origin and arrangement of the smaller arteries also existed, but none of these was of special importance.





[The woodcut represents the two last lumbar vertebrae and the sacrum seen in section, and the right side of the pelvis. The iliacus and obturator internus muscles remain in their places, covered by their respective fasciae. A triangular flap of the abdominal wall, having the epigastric artery on its inner surface, is also shewn. The symphysis of the pubes, and a portion of the boundary of the obturator foramen, were removed in making the *post-mortem* examination.

- a, Triangular flap of the wall of the abdomen.
- b, Gimbernat's ligament.
- c, Iliacus muscle.
- d, Obturator internus muscle, covered by fascia.
- e, Coccygeus muscle and small sacro-sciatic ligament.
- f, Spermatie cord.
- g, Obturator nerve.
- h, Nerves forming the sacral plexus

#### Vessels.

- 1, Aorta.
- 2, Right common iliac artery.
- 3, External iliac artery.
- 4, Circumflex iliac artery.
- 5, Cremasteric artery arising from the external iliac.
- 6, Right internal iliac artery.
- 7, Common trunk of the obturator and epigastric arteries.
- 8, Obturator artery giving a branch to anastomose with the pudic.
- 9, Obturator vein.
- 10, Epigastric artery furnishing a branch to ramify behind the pubes, and another to pass through the crural ring.
- 11, Pudic artery.
- 12, Ischiadic artery.
- 13, Right external iliac vein.]

An instance almost precisely similar is recorded by A. K. Hesselbach,<sup>1</sup> in which a common trunk for the obturator and epigastric arteries arose from the internal iliac as its third branch, and divided

<sup>1</sup> Ueber den Ursprung und Verlauf der unteren Bauchdeckenschlagader und der Hüftbeinlochschlagader. 4to. 1819.

at an inch and four lines from the transversalis fascia. The obturator descended towards the front, to the obturator foramen,—the epigastric passed forwards on the inner side of the external iliac vein, as far as Ponpart's ligament, where it turned up and ascended obliquely upon the posterior surface of the rectus muscle.

Dr Monro also met with a similar case, but he merely says, in speaking of it<sup>1</sup>—"I have a specimen in which the epigastric artery takes its rise from the obturator, and passes upwards and inwards to the rectus muscle."

Not having been able to find any other recorded case of the same kind, I believe that the one now given is the third instance in which this origin of these important arteries has been noticed, and the only one in which anastomosing branches were sought for, with a view to ascertain the causes or modes of production of such varieties. It is necessary to notice here, the occurrence of two epigastric arteries, one furnished by the external, the other by the internal iliac, and lying on different sides of the spermatic cord, as observed by Lauth, and mentioned by M. Velpeau;<sup>2</sup>—the origin of the epigastric artery from the femoral (Burns<sup>3</sup> and Quain<sup>4</sup>); from the superficial femoral (Burns); from the profunda femoris (Monro, Green,<sup>5</sup> Hesselbach, Tiedemann,<sup>6</sup> and Quain); or from the internal circumflex (Dr John Reid<sup>7</sup> and Michelet<sup>8</sup>);—the common origin of the epigastric, obturator, and circumflex iliac, or internal circumflex of the thigh from the femoral (Quain and Hesselbach);—the origin of the epigastric with the internal circumflex and circumflex iliac arteries (Hesselbach), or with either of these (Quain);—the origin of the obturator from the profunda femoris (Green and Hesselbach); or from the superficial femoral (Monro and Burns);—and the origin of the internal circumflex from the external iliac (Burns); from the circumflex iliac or obturator (Quain); or from the epigastric (Quain and Dr John Reid.)

<sup>1</sup> The Morbid Anatomy of the Human Gullet, Stomach, and Intestines. By Alexander Monro, jun. Edinburgh, 1811, p. 427.—My kind friend, Mr Spence of Edinburgh, whose valuable papers on the arrangements of the arteries of the pelvis have added so much to our knowledge of their importance in operations, kindly undertook to make inquiry for me regarding the case which occurred to Dr Monro. Unfortunately, however, the preparation cannot be found, and Dr Monro has no recollection of its nature.

<sup>2</sup> Nouveaux Eléments de Méd. Opératoire. Paris, 1832. Tom. ii. p. 452; or Brussels edition, 1835, p. 392.

<sup>3</sup> Observations on the Diseases of the Heart, &c. Edinburgh, 1809.

<sup>4</sup> The Anatomy of the Arteries of the Human Body, with lithographic drawings and commentaries. By R. Quain. London, 1844.

<sup>5</sup> Cyclopædia of Practical Surgery; article—Arteries—Anomalies of.

<sup>6</sup> Tabulæ Arteriarum Corporis Humani. Tab. xxxiii., fig. 3.

<sup>7</sup> Anatomical Observations, in No. 128 of the Edinburgh Med. and Surgical Journal.

<sup>8</sup> Nouveaux Eléments de Médecine Opératoire. Par M. Velpeau. Tom. ii. p. 452.

These comprise the whole recorded variations in the origin and connections of the epigastric artery, as far as I can ascertain; and it will be seen by a reference to the case which I have just related, that there is good reason to believe that the position of the vessel in all its varieties of origin may be explained by the enlargement of anastomosing branches, which probably always exist, at some period of development, between the larger trunks; and many of which were large enough, in the present instance, to admit ordinary coarse injection. Thus, the epigastric, generally arising from the external iliac artery, communicates by branches which ramify behind the pubes with the obturator artery of the internal iliac trunk, and in three instances it has appeared to arise altogether from the last-named vessel. Under such circumstances, it might be expected that a communication would exist between the epigastric of the internal iliac and the external iliac artery, and it is very possible that such a connection does take place, though, as in the present instance, the branches may not be of sufficient size to become evident after the use of coarse injection. This appears more probable when it is considered that the cremasteric branch was, in this case, still connected with the external iliac artery, though no communication existed between the former and the epigastric. No mention is made of the position of anastomosing vessels in the cases recorded by Hesselbach and Dr Monro, nor in the one mentioned by M. Velpeau as occurring to Lauth; and this is especially to be regretted in the latter case, as in it the supply of blood usually conveyed by the epigastric was furnished by two branches, one arising from the external, the other from the internal iliac artery. Further explanation is also required of the cause of the position of the common trunk of the two arteries, in the instance now recorded, not being that of the ordinary obturator, the position of which is very nearly occupied by a small vessel running forwards in close relation with the obturator vein. It is more than probable that this explanation would have been afforded by Lauth's case, if the epigastric branch, which arose from the internal iliac, had been fully described and found unassociated with the obturator.

By reference to the woodcut here given, it will be seen that a considerable branch connects the obturator and pudic arteries on the surface of the obturator internus muscle; and other modes of connection of these vessels have been seen by others—thus Haller<sup>1</sup> observed several instances in which their branches anastomosed in supplying the penis, and two cases in which the branch to the penis was furnished by the obturator, an occurrence which, he states, was also observed by Lieutaud and Columbus. Mr Quain has shown the accessory pudic artery to be derived, in different instances, from the pudic in the pelvic cavity,—from the internal iliac,—from the exter-

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<sup>1</sup> *Icones Anatomicæ*. Gottingue, 1743. Fascic. iv., p. 32.



nal iliac by means of the obturator arising from the epigastric,—or from the epigastric artery.

Again, the internal circumflex artery sometimes arises from the external iliac, the epigastric or obturator; and the epigastric and obturator vessels have been found arising from the femoral, the profunda femoris, or from the internal circumflex arteries, and proceeding to their destination through the crural canal, in which position a small branch from the epigastric artery will be found in the accompanying wood-cut.

So it appears very generally to be true that varieties in the position or origin of the larger arteries result from the enlargement of their usual anastomosing branches with other vessels, the artery which occupies the normal position becoming at the same time proportionally diminished in its diameter. This is remarkably exemplified by the obturator artery, which, in different instances, arises from the internal iliac,—from the epigastric branch of the external iliac, or from the trunk itself,—or again, from both iliac arteries at once, by branches either of equal or of different sizes, as has been so beautifully demonstrated by Professor Quain and Mr Maelise; and a few other instances of removal of the epigastric artery from the external iliac, may give as complete an explanation of the manner in which its varieties become developed.

However great the interest which is excited by varieties in the position and origin of arteries when viewed physiologically, it can never equal in importance that which they acquire from their surgical relations. These are so important, in the case of the epigastric and obturator arteries, that all their varieties have ever been regarded with peculiar anxiety; and the estimate of the increased amount of danger which they may occasion under various circumstances yet remains a desideratum. To attain this, it appears necessary, 1st, to review those varieties of position in which a vessel of considerable size appears likely to be exposed to danger in the performance of ordinary operations, and, if possible, to ascertain the frequency of like positions; 2nd, to inquire in what proportion of such operations vessels of importance have been injured in actual practice; and, 3d, to determine the probable result of future cases of injury of these vessels, by a reference to the termination of those which have already been made public. In what follows, these inquiries will be pursued as far as our present imperfect data will warrant, and they will be limited to those arteries which may possibly be endangered by the ordinary operations for inguinal and femoral hernia.

*Inguinal Hernia.*—The epigastric artery has a remarkably constant position in all the various forms of inguinal hernia, lying on the inner side of the internal abdominal ring and the neck of an oblique hernia, and to the outer side of the neck of the sac of both superior and inferior direct herniæ. To this general rule there ap-

pear only two exceptions, one being in a case of internal labial hernia, recorded by F. C. Hesselbach;<sup>1</sup> the other, Lauth's case before named. In Hesselbach's case "the obturator artery arose from the inner side of the crural more than half-an-inch distant from the internal inguinal ligament (*transversalis fascia*), and running for the length of an inch obliquely downwards and inwards over the crural vein, bent suddenly, on the horizontal ramus of the pubes, towards the obturator foramen; from this bend arose the epigastric artery, which proceeded transversely inwards on the horizontal ramus of the pubes, behind the neck of the hernial sac, and ascended on its inner side to get behind the rectus muscle of the abdomen, accompanying the ligamentous remains of the umbilical artery which were close behind it."

The epigastric artery is carried inwards to the edge of the rectus muscle by large oblique scrotal herniæ of long standing, but in no instance has it been found in such a position as to be endangered by the division of the stricture upwards, a plan now almost universally adopted in all cases of inguinal hernia. Though, in ordinary cases, this artery could not be injured by the division of the stricture of an oblique inguinal hernia upwards and outwards, and that of direct inguinal herniæ upwards and inwards, it has been fully shown that these different forms of inguinal rupture cannot always be distinguished from each other, and, consequently, that such methods of operating must occasionally lead to fatal results. Moreover, there are other sources of danger; for if, in such a case as Hesselbach's above referred to, the stricture of an inferior direct hernia were to be cut upwards and inwards, the edge of the knife would be applied upon the epigastric artery, and a similar occurrence would take place in the division of the stricture of an oblique hernia upwards and outwards, in any instance like that named by Lauth and Velpeau.

The following cases of injury of important arteries, in operations for inguinal hernia, are on record:—

1. Scrotal hernia—Stricture cut by Sir A. Cooper<sup>2</sup> upwards and outwards; epigastric artery divided; hemorrhage stayed for four hours by pressure in the groin; death in ten hours after operation; abdomen distended with blood.

2. Inguinal hernia caused by the kick of a horse—Stricture cut upwards, and epigastric artery completely divided; both ends were tied; ligatures were brought away on the eleventh day; the wound was healed on the fourteenth, and the patient returned to his work

<sup>1</sup> *Disquisitiones Anatomico-pathologicæ de Ortu et Progressu Herniarum, cum Tabulis xvii. æneis.* Wirceburgi, 1816, p. 15.

<sup>2</sup> *The Anatomical and Surgical Treatment of Inguinal Hernia, First Part.* London, 1827, p. 69.

on the sixteenth day after operation. This operation was performed by Dr Mackay, R.N., assisted by Mr Giraud of Faversham, who communicated the particulars to Sir A. Cooper.<sup>1</sup>

3. A small oblique inguinal hernia passing down by the side of the sac of an older hernia full of fluid—Stricture divided inwards; immediate and copious hemorrhage from the epigastric artery stopped by fainting; recurrence of very serious hemorrhage owing to a clot being forced out by vomiting; hemorrhage finally suppressed by lint thrust into the wound, and by pressure in the groin kept up for four days; lint removed without hemorrhage after four days; occupation resumed after five weeks. The case occurred to Mr Davie, but is recorded by Sir A. Cooper,<sup>2</sup> who states that he could give other and similar cases, had he the permission of the surgeons attending.

4. Oblique inguinal hernia—Division of the tendon of the external oblique muscle upwards and outwards for two inches, also upwards and inwards for three-fourths of an inch; complete division of the epigastric artery, at three-quarters of an inch from its origin, by the incision made upwards and inwards, including the inferior margin of the internal oblique and transversalis; no hemorrhage; death on the following evening from mortification of the intestines. Recorded by Mr Laurence.<sup>3</sup>

5. Direct inguinal hernia—Stricture cut upwards and outwards to a very slight extent, and not within three-fourths of an inch of the epigastric artery; division of the cremasteric branch of the epigastric; hemorrhage, the same evening, restrained by cold cloths; profuse arterial hemorrhage on the eighth day, ceasing after the loss of two pints of blood; death, a week after the last hemorrhage, from inflammation. Recorded by Mr Laurence.<sup>4</sup>

6. Scrotal hernia, of nine years' standing, in a patient æt. 64—Inflammation and suppuration of the whole scrotum; hemorrhage on the tenth day; castration for the purpose of securing the vessel; loss of above a pound of blood; gradual recovery. Recorded by Sir E. Home.<sup>5</sup>

7. Scrotal hernia of eight or nine years' standing—Considerable

<sup>1</sup> Op. Cit., p. 41.

<sup>2</sup> Op. Cit., p. 69.

<sup>3</sup> Treatise on Ruptures, Fifth Edition. London, 1838, p. 271.

<sup>4</sup> Op. Cit., p. 273.

<sup>5</sup> Transactions of a Society for the Improvement of Medical and Chirurgical Knowledge. London, 1800. Vol. ii., p. 105.



hemorrhage, soon after the operation, restrained by the application of sponge; recovery. Recorded by Mr William Chalmers.<sup>1</sup>

8. Scarpa says,<sup>2</sup> in speaking of wounds of the epigastric artery, "I have had the misfortune to be an eye-witness of this severe and irreparable accident, supervening upon an operation performed in a dexterous manner, and with the greatest facility."

9 and 10. Bertrandi writes,<sup>3</sup>—"I can affirm that I have opened the bodies of men who have died a few hours after this operation, although performed with great facility, dexterity, and quickness, so that the operators thought highly of themselves on that account; and they were quite astonished, and could not understand the cause of so unexpected death; but their astonishment ceased when they saw the abdomen full of blood, discharged from this artery (the epigastric) wounded.

11. Leblanc<sup>4</sup> also speaks of having seen the epigastric cut by expert operators.

12. Mennel<sup>5</sup> opened an artery in cutting the stricture inwards. The hemorrhage was considerable, but was controlled after a quarter of an hour.

13. Saviard<sup>6</sup> (Obs. 20) saw a hemorrhage which occurred half-an-hour after an operation, and was arrested by compression. Four or five *palettes* (sixteen to twenty ounces) of blood were lost.

Numerous cases are recorded where death resulted from wounds of the epigastric and other arteries in the operation of paracentesis. Mr Edward Ford<sup>7</sup> relates a case of Mr Pearson's, in which death took place in twelve hours, and a large quantity of coagulated blood was found in the abdomen; and at page 135 of the same publication, he speaks of a like case, where he stopped very serious hemorrhage by pressure of the integuments and muscles between the fingers and thumb for six hours. Mr Ford also knew of similar hemorrhage in the hands of other surgeons. Dr James Carmichael Smyth<sup>8</sup> gives the case of a man, æt. 36, who died in forty-eight

<sup>1</sup> Medical and Philosophical Commentaries by a Society in Edinburgh. London, 1773. Vol. i., p. 413.

<sup>2</sup> Wishart's Translation of Scarpa on Hernia, p. 125.

<sup>3</sup> Traité des Operations de Chirurgie, traduit de l'Italien. Paris, 1769, p. 29.

<sup>4</sup> Précis d'Opérations. Paris, 1775. Tom. ii., p. 129.

<sup>5</sup> Sec F. A. Waitz, Med. Chirurg. Aufsätze, vier Theil, p. 123.

<sup>6</sup> Traité des Hernies de A. G. Richter. Par J. C. Rougemont. Seconde Edition, Cologne. Tom. i., p. 324.

<sup>7</sup> Medical Communications. London, 1790. Vol. ii., p. 136.

<sup>8</sup> Medical Communications, vol. ii., p. 482.



hours from hemorrhage, caused by puncture of the epigastric artery in tapping for ascites; and another case, where profuse hemorrhage occurred, and the patient died some weeks after the operation. He also speaks of eight other cases which happened in the practice of various surgeons of his acquaintance. A fatal case is given in Kleinert's Repertorium, Nov. 1835, from wounding an anomalous branch of the epigastric. Ramsay<sup>1</sup> gives a fatal case from puncture of the abdominal branch of the circumflex iliac artery; and Allan Burns<sup>2</sup> also speaks of wounding the same artery, or its accompanying veins, in paracentesis.

It appears, therefore, that serious hemorrhage is to be expected after wounds or division of the epigastric artery, and that no reasonable hope can be entertained that such cases will have a favourable termination without prompt interference by the surgeon. Mr Laurence's case of complete division of the epigastric without hemorrhage must be viewed as an exception to the rule, and it should not prevent the surgeon cutting down upon the divided artery and tying both ends, if possible, in every instance in which it is known to have been wounded, for a fatal result from internal hemorrhage is very likely to take place, even in instances in which no blood escapes externally. As a fatal hemorrhage may proceed from division of the cremasteric branch of the epigastric, such a case should be treated like cases of hemorrhage from the trunk of that vessel.

But the most important question to decide is, whether the epigastric or other large artery ever lies in such a position, in regard to an inguinal hernia, as to be endangered by the operation now commonly practised? Hitherto the epigastric has been situated either on the inner or outer side of the neck of the sac of every inguinal hernia which has been examined, and in no single instance has any large vessel been found on the upper part of the neck of the sac of any such hernia. Scarpa cut the stricture upwards in several cases of oblique and direct inguinal hernia in the dead body, and he says<sup>3</sup> that in all "the epigastric artery remained uninjured, although the incision was extended an inch above the inguinal ring." There ought therefore to be no risk of hemorrhage, in any case, from cutting the stricture directly upwards; but, in the second case before referred to, as recorded by Sir A. Cooper, the epigastric is said to have been completely divided by cutting upwards. On referring to the particulars of this case, it will be seen that the stricture was found from an inch to an inch and a-half distant from the external abdominal ring, and that it was divided, without exposure of the canal by the division of any part of the tendon of the external oblique muscle, whence it may reasonably be doubted whether, under such circum-

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<sup>1</sup> Edinburgh Medical and Surgical Journal, vol. viii., p. 282.

<sup>2</sup> Observations on the Diseases of the Heart, &c. Edinburgh, 1809, p. 317.

<sup>3</sup> Wishart's Translation, p. 130.

stances, it was possible to cut the stricture directly upwards. The probability is, that the edge of the knife was directed upwards and inwards, and the incision made exactly at the part invariably occupied by the epigastric artery in such forms of hernia. Whilst this case cannot be considered as indicating the existence of the slightest risk in the ordinary plan of dividing the stricture directly upwards in every form of inguinal hernia, it offers a very serious warning against the division of the stricture of any hernia whatever, without as complete exposure of the strictured part as can be secured under the circumstances.

In every variety of inguinal hernia it may be safely asserted that there is not the slightest risk of hemorrhage from the division of the stricture directly upwards.

*Femoral Hernia.*—The crural ring and the neck of an ordinary femoral hernia, have the following relations to important vessels:—Immediately outside, with the femoral vein; above and on the outer side, with the epigastric artery, at the distance of half-an-inch; immediately above, or in front, with the round ligament in the female, and the spermatic cord in the male, the spermatic artery and the cremasteric branch of the epigastric being not more than half-an-inch distant from the neck of a recent hernia, and within two or three lines of one which has dilated the aperture.

It is probable, as appears from the researches of Mr Quain, that the inner side of the ring has no large vessel upon it in about 90 cases per cent., but in the rest this position may be occupied by the obturator or epigastric arteries,—by a considerable branch of communication between these two vessels, this branch, at times, becoming so large as to constitute a second origin of the obturator,—or by small branches of the epigastric ramifying behind the pubes.<sup>1</sup>

The obturator artery runs in front and on the inner side of the ring in 2·8 cases per cent.; and in 10·46 instances per cent. it crosses the opening<sup>2</sup> and is displaced by the occurrence of a hernial protrusion, being tensely stretched over the inner side of the neck of the sac, or pushed outwards against the external iliac vein. It may even be found below or behind the neck of the sac (Cloquet).<sup>3</sup> When two femoral herniæ occur, the obturator artery, arising from the external iliac by a common trunk with the epigastric, may pass be-

<sup>1</sup> See Mr Quain's Plate 68, Figs. 3 and 4, shewing the obturator artery passing over the anterior and inner side of the neck of the sac of a femoral hernia: Plate lxxii. Fig. 1, shewing the epigastric close to the iliac vein, in Hesselbach's case, and the wood-cut here given, for the epigastric crossing the crural ring: Mr Quain's Plate lxvi. Fig. 1, for a branch of artery crossing the ring, and communicating between the obturator and epigastric arteries; and Plate lxvi. Fig. 3, for a similar branch much enlarged, and curving over the anterior and inner side of the ring.

<sup>2</sup> See Mr Quain's Commentaries on the Arteries, p. 451.

<sup>3</sup> Recherches Anatomiques sur les Hernies de l'Abdomen. 4to, Paris, 1817. P. 86, prop. 50.

tween them in its course into the pelvis, as in a case dissected by Allan Burns, in which he says, one hernia passed into the sheath of the lymphatics, and the other into that of the vein.<sup>1</sup> The course taken by the obturator varies very much even when it arises in the same position, so that its relation with the inner or outer side of the neck of a femoral hernia does not altogether depend on the length of the common trunk by which it and the epigastric artery arise from the external iliac.

The epigastric artery, arising from the internal iliac by a common trunk with the obturator, may lie on either side of the neck of a crural hernia. In Hesselbach's case it was close to the iliac vein, and would have been on the outside of the neck of a hernial sac. In the case here recorded the artery crossed the aperture, and would probably have been displaced with equal readiness to either side; whilst in Dr Monro's case, no mention is made of the position of the artery. One of the two epigastric arteries seen by Lauth, arising from the external and internal iliac arteries respectively, would in all probability have been close to the neck of a femoral hernia, but nothing is recorded of their relative position further than that they were placed on opposite sides of the spermatic cord. Arnaud<sup>2</sup> has an engraving showing the epigastric artery arising from the inner side of the external iliac, and passing under the external iliac vein, along the outer side of the femoral ring, to gain the abdominal wall.

*Relations of the Sac of a Femoral Hernia to large vessels.*—The sac of an ordinary femoral hernia may have the epigastric, obturator, or internal circumflex arteries, in front of it, as appears from a case seen by Dr P. Hennis Green,<sup>3</sup> in which the epigastric was given off by the profunda femoris, and passed very far forwards in ascending;—from one or two subjects in which the epigastric arose from the femoral, and passed in front of the sheath of the lymphatics, to gain the abdomen;—from one or two cases where the epigastric arose from the superficial femoral;—from a very long epigastric artery being protruded into the front of the crural canal,—all which cases were observed by Allan Burns; <sup>4</sup>—from two instances in which Dr P. H. Green observed the obturator to arise from the femoral artery, and to advance so far forwards in ascending internal to the femoral vein, that, he says, a hernia must have passed behind it;—and from an instance recorded by Burns (p. 319), in which the internal circumflex artery arose from the external iliac, and passed in front of the sheath in descending to the thigh. Dr Monro saw a branch of the circum-

<sup>1</sup> Observations on Diseases of the Heart, and on the Larger Arteries. By Allan Burns. Edinburgh, 1809. P. 313; and Dr Monro's Plate xvi., Fig. 2. op. cit.

<sup>2</sup> Mémoires de Chirurgie. Paris, 1768. Tom. ii. p. 782.

<sup>3</sup> Cyclopædia of Practical Surgery. Article—Arteries—Anomalies of.

<sup>4</sup> Op. citat., p. 316.



flex iliac artery, which, he says,<sup>1</sup> was nearly as large as the epigastric, and might have been divided in an operation for femoral or inguinal hernia. It passed under the crural arch, about two inches from the symphysis pubis, and then divided into branches, which were distributed upon the symphysis, over the crural arch, and on the iliac portion of the fascia lata.

The posterior surface of the sac may be in contact with the obturator artery, when this arises from the superficial femoral, two inches below Poupart's ligament, and ascends on the posterior part of the sheath, as in two cases recorded by Allan Burns (p. 315). The inferior and internal border of the neck of the sac of a femoral hernia, examined by Hesselbach, had the epigastric artery running along it, after arising from the profunda femoris. Mr Quain has an instance (Plate lxxiv. Fig. 3), in which the internal circumflex and epigastric arteries arise, by a common trunk, below Poupart's ligament, the internal circumflex curves over the femoral vein, by the side of the crural canal, and the epigastric passes through the ring in front and on the outer side. He has also an instance (Plate lxxiv. Fig. 4), in which the obturator, epigastric, and internal circumflex arteries, arise by a common trunk below Poupart's ligament, the internal circumflex, in this instance also, turns over the femoral vein, and both the obturator and epigastric arteries pass into the abdomen through the crural ring. Michelet<sup>2</sup> saw the epigastric artery arise from the internal circumflex in the thigh, and then ascend to its ordinary position; and Dr John Reid<sup>3</sup> found the epigastric arising from the internal circumflex in one case, and the internal circumflex from the epigastric in another; the epigastric, in the first instance, and the internal circumflex in the other, being in such positions that they would probably have lain on the outer side of a femoral hernia if one had descended.

There are, perhaps, no large arteries in the body so likely to present numerous and considerable irregularities in their origin and course as those which have been named in connection with the femoral ring and canal, and there is certainly no other space so limited, and, at the same time, so likely to present us with irregular arteries of such great surgical importance, both from their size and position. There is scarcely any spot around the neck, or on the body of a crural hernia, lying within the canal, which may not be occupied by a large artery; but the instances in which any large vessel, except the femoral vein, lies in relation with the boundaries of the canal, are exceedingly rare; and should an artery lie in such a position, and be wounded during the performance of an operation, it is satisfactory to

<sup>1</sup> Op. citat., p. 431.

<sup>2</sup> Nouveaux Eléments de Méd. Opératoire. Par M. Velpeau. Paris, 1832. Tom. ii. p. 452.

<sup>3</sup> Anatomical Observations in Edinburgh Medical and Surgical Journal, No. 128.



know that it will be in a position in which it can be exposed and secured without any serious consequence. But it is very different with vessels which may be found *in front, or inside the neck*, of a similar hernia, for these could scarcely be secured if divided, and a fatal result might be expected from internal hemorrhage. Here it is to be remembered that the obturator artery arises from the epigastric, and passes in front of the neck of the sac of a femoral hernia, to gain its inner side in 2·8 cases per cent., and that it would in all probability occupy the same position in several of the 10·46 other cases per cent., in which it was found<sup>1</sup> passing across the aperture when no hernia had been formed. In either sex, therefore, the division of the femoral ring upwards would be attended with great danger of hemorrhage in the proportion of cases just named, the whole amount of danger to the patient being in proportion to the difficulty of securing the vessel when divided, and to the length of the incision, which will require to be greater when this is made upwards than when it is directed inwards. In a male, other dangers attend the division of the stricture upwards, for the spermatic artery is greatly endangered if the testis has descended, and though it may be secured if divided, the testis will thus be sacrificed; consequently, a stricture at the neck of a femoral hernia, in the male, never ought to be divided directly upwards.

As, however, there can be no doubt that the tight stricture formed by the femoral ring, is most effectually relaxed by the division of the edge of Gimbernat's ligament, or the angle of connection between it and Poupart's ligament, where the fascia lata is attached to both, *i. e.*, by cutting inwards, or upwards and inwards, we are more especially concerned with the dangers which result from the adoption of such methods of operating in 2·8 cases per cent., in which the obturator artery passes in front of the crural ring, and descends near to the edge of Gimbernat's ligament;—in about 5 cases per cent., in which the same artery would be so displaced by the occurrence of a hernia, as to lie tightly stretched over the front and inner side of its neck;—in an instance like that recorded in this paper, where the epigastric artery might have been displaced by a hernia, and stretched over the inner side of its neck;—and in the few cases in which considerable communications exist between the epigastric and obturator arteries by vessels running near to the edge of Gimbernat's ligament. The most important inquiry bearing on this point is whether arteries lying in the positions which have just been named, must necessarily be divided with the tense edge of the ring in an operation. If the mode of connection of such vessels with Gimbernat's ligament be examined, it will be found to be maintained by loose cellular tissue, readily allowing of slight displacement of the vessels,

<sup>1</sup> Quain's Commentaries.

so that in those instances in which a vessel has not been displaced by the descent of a hernia, and thus stretched tensely over its neck, there is no doubt that it may be avoided,<sup>1</sup> even though running across the direction of the line of incision. This is to be accomplished by passing no more than the blunt point of the bistoury beyond the edge of the stricture, and then dividing the tense fibres by pressing the edge of the knife rather upon the anterior surface than directly on the edge of the ligament, in carrying the handle inwards, or upwards and inwards. So few fibres require to be divided—and these, too, at a time when they are stretched to the utmost—that an artery which is neither tense nor firmly attached to the part to be divided, may frequently escape in a carefully-conducted operation; but an obturator, or epigastric artery, which, in the natural state, ran across the femoral ring, and, by the protrusion of a hernia, has been displaced inwards, will be tensely stretched across the direction of the incision inwards, or upwards and inwards, and will consequently be in great danger. If a vessel, in such a position, can be avoided, it will assuredly be by the same method as secures an artery not displaced by the hernia.

When a hernia passes under some other part of the crural arch than at the ring, its relations to the vessels differ very materially. Two herniæ passing out of the abdomen, close to the outer side of the femoral vessels, were dissected by Mr Stanley;<sup>2</sup> in both, the sac, about the size of a walnut, was placed directly in front of the femoral artery and vein. In one of these instances the epigastric artery arose from the femoral and gave origin to the obturator. The common trunk, and its division into the epigastric and obturator branches, were placed in front of the sac. A. K. Hesselbach<sup>3</sup> met with a hernia between the anterior-superior spinous process of the ilium and the great vessels. Its fundus lay beneath the iliac portion of the fascia lata, and the neck was crossed anteriorly by the circumflex iliac artery. Seven cases of femoral hernia, protruding outside the femoral vessels will be found noticed in the Register of the London Truss Society;<sup>4</sup> and the same occurrence is no-

<sup>1</sup> An interesting case is recorded by Breschet, in which Gimbernat's ligament was divided to the extent of two lines. On reducing the hernia, and passing up the index finger, the pulsations of an artery were distinctly felt on either side of the ring. The patient died, and, on examination, it was found that the obturator artery lay on the inner side of the neck of the sac, and would have been divided had the incision been carried one or two lines further. The epigastric artery ran along the outer side of the sac, but was distant from it four or five lines, while the spermatic and supra-pubic arteries lay so much in front that they would have been wounded by carrying the incision directly upwards.

<sup>2</sup> Laurence's Treatise on Ruptures. Fifth edition. P. 436.

<sup>3</sup> Lehre von den Eingeweidebrüchen. Würzburg, 1829.

<sup>4</sup> Laurence on Ruptures. Fifth edition. P. 11.

ticed by Petit,<sup>1</sup> Sabatier,<sup>2</sup> Callisen,<sup>3</sup> Arnaud,<sup>4</sup> Richter,<sup>5</sup> Richerand,<sup>6</sup> and Maclise.<sup>7</sup> A hernia in front of the femoral vessels, having the epigastric artery along the inner border of the sac, was observed by Cloquet,<sup>8</sup> who also saw one which passed through the posterior part of the femoral sheath, and lay on the pectineus muscle, having the pubic portion of the fascia lata, and the femoral vessels, in front. The occurrence of hernia in front of the vessels is likewise mentioned by Callisen, Richerand, Arnaud, and Richter.<sup>9</sup>

In the following cases vessels of importance have been injured in operations for strangulated femoral hernia:—

1. Hospital of La Charité at Berlin—Strangulated femoral hernia in a female—crural ligament divided by incision parallel to horizontal ramus of pubes—death eight days afterwards, from trismus and opisthotonos—the obturator artery was found cut—it arose from the epigastric, and passed in front and on the inner side of the neck of the sac—six ounces of putrid blood were found in the cavity of the pelvis.<sup>10</sup>

2. Femoral hernia passing through the ring and having the obturator artery on the inner side, the epigastric on the outer, with both vessels crossing immediately in front of the tumour—coat of the obturator grazed by the knife in the operation—hemorrhage supervened on the eighth day, and carried off the patient. The case was Mursinna's, and is mentioned by Robert.<sup>11</sup>

3. Strangulated femoral hernia in a male, æt. 22, operated on by Arnaud in 1736—Stricture divided upwards—no unusual hemorrhage externally—death in an hour after operation—spermatic artery found divided, and a large effusion of blood in the abdomen.<sup>12</sup>

4. Strangulated femoral hernia in a female—Stricture divided upwards and outwards—incision extended in the same direction—

<sup>1</sup> *Traité des Maladies Chirurgicales*. Nouvelle édition. Paris, 1790. Tom. ii. p. 219.

<sup>2</sup> *Médecine Opératoire*. Tom. i. p. 143.

<sup>3</sup> *Systema Chirurg. Hodiern.* Pars, post., p. 495.

<sup>4</sup> *Mémoires de Chirurgie*. Tom. ii., p. 779 and 768.

<sup>5</sup> *Traité des Hernies*. Tom. ii., p. 138.

<sup>6</sup> *Nosographie Chirurg.* Cinquième édition, Paris, 1821. Tom. iii. p. 404.

<sup>7</sup> *Surgical Anatomy*. By J. Maclise. London, 1850. Note to Commentary on Plate xxiv.

<sup>8</sup> *Recherches Anatomiques sur les Hernies*. Paris, 1817. Page 85, props. 46 and 48.

<sup>9</sup> *Opera Citata*.

<sup>10</sup> *De Extensionis in Solvendis Herniis Cruralibus incarceratis præ Incisione præstantia*. By F. L. Trüstedt. 4to, Berol. 1816. Quoted in Cooper's *Surgical Dictionary*, p. 741.

<sup>11</sup> *Journal des Progrès des Sciences Médicales*. Tom. vii., p. 193.

<sup>12</sup> *Mémoires de Chirurgie*. Paris, 1768. Tom. ii. p. 755.

wound then immediately filled with arterial blood—the vessel could not be seen—complete cessation of hemorrhage from fainting after the loss of a pint of blood—complete recovery. Case recorded by Mr Laurence.<sup>1</sup>

5. Strangulated femoral hernia in a female—Profuse arterial hemorrhage after division of the stricture—source of hemorrhage could not be discovered—the patient became faint—a compress and bandage were applied, and the bleeding ceased. Operation performed and case recorded by Mr Laurence.<sup>2</sup>

6. Strangulated femoral hernia in a female—Operation performed by Professor Benedict, of Breslau—a winged probe was introduced into the neck of the sac, and stricture cut from without inwards and from below upwards—epigastric artery, running along the neck of the sac was divided—free hemorrhage—the mouth of the vessel was immediately seized by an assistant, and easily tied.<sup>3</sup>

7. Strangulated femoral hernia in an aged female—Mr Hey's Case 9<sup>4</sup>—Stricture cut directly upwards for half an inch, and not on the inner side of the intestine—copious arterial hemorrhage—no orifice to be seen—hemorrhage suppressed by dry sponge, a bandage, and pressure exerted by an assistant, during the first day after operation—sponge removed on the 14th day—wound cicatrised at the end of five weeks.

8 and 9. Mr Guthrie states,<sup>5</sup> that he has been made aware of more than one instance of the obturator artery, surrounding the neck of the sac, having been wounded by some of the best anatomists and surgeons in London, in the division of Gimbernat's ligament horizontally, and that the patients subsequently bled at intervals, until they died from hemorrhage.

10. Strangulated femoral hernia in a female, æt. 60—Operation performed by Dupuytren, at the Hôtel-Dieu, in 1831, and witnessed by Dr John Reid—hemorrhage during the operation greater than usual, but it soon ceased—patient went on well for a fortnight, when she was seized with severe diarrhœa, which soon carried her off—a broad sheet of blood was found between the peritoneum and the fascia transversalis, extending from the lower part of the pelvis up nearly to the umbilicus. The obturator artery, which arose from

<sup>1</sup> Op. cit., p. 272.

<sup>2</sup> Op. cit., p. 512.

<sup>3</sup> Rust. Magazin für die gesammte Heilkunde, vol. xlv., p. 173.

<sup>4</sup> Practical Observations in Surgery. By Wm. Hey, 2d edition, 1810, p. 160.

<sup>5</sup> Guthrie on Some Points connected with the Anatomy and Surgery of Inguinal and Crural Hernia, 4to, p. 36.



the epigastric, nearly surrounded the neck of the sac, and had been completely divided in the operation. Recorded by Dr J. Reid.<sup>1</sup>

11 and 12. Guntz<sup>2</sup> heard of two instances in Paris in which the epigastric artery was cut in dividing the stricture upwards, and the patients died from hemorrhage.

13. Sabatier<sup>3</sup> states, that a fatal hemorrhage has been seen to follow the division of Gimbernat's ligament, in the operation for strangulated femoral hernia, owing to the section of small branches of the epigastric artery.

14. Hospital of La Charité, Paris—Strangulated femoral hernia—stricture divided inwards—considerable hemorrhage, arrested by a graduated compress, the farthest extremity of which projected into the iliac fossa—compress removed in five days, without farther hemorrhage. Recorded by M. Velpeau.<sup>4</sup>

15 and 16. Two cases of strangulated femoral hernia mistaken for inguinal—stricture divided outwards, and femoral vein wounded in both cases—profuse hemorrhage, restrained with great difficulty. Mentioned by Sir A. Cooper.<sup>5</sup>

17, 18, and 19. Dr P. Hennis Green says,<sup>6</sup>—"The late Dr A. Thomson has assured us, that he had positive proofs that Dupuytren wounded the epigastric artery on three several occasions." (Yet Dupuytren endeavoured to avoid this by cutting that portion of the fascia lata which is attached to the crural arch, rendering it tense.)

20 and 21. M. Robert<sup>7</sup> examined the bodies of two persons who died from hemorrhage under circumstances similar to those in the last three cases.

22. A case occurring to M. La Chaud—Femoral hernia in a female—epigastric or circumflex iliac artery divided in an operation performed in the presence of Arnaud, by whom the case is named.<sup>8</sup> (The probability is, that the stricture was cut upwards, and that death was the result, though no positive statement is made on these heads.)

<sup>1</sup> Anatomical Observations, in Ed. Med. and Surg. Journal, No. 128.

<sup>2</sup> Obs. Anatomico-Chirurg. de Herniis Libellus. Lips. 1744.

<sup>3</sup> De la Médecine Opératoire. Par R. B. Sabatier. Nouvelle édition, par Sanson et Begin. Paris, 1832. Tom. iii., p. 608.

<sup>4</sup> Médecine Opératoire. Tom. ii., p. 489.

<sup>5</sup> On Crural Hernia. Op. cit., 2d edition, p. 4.

<sup>6</sup> Cyclopædia, ante cit.

<sup>7</sup> Nouvelle Méthode pour le Débridement de la Hernie Crurale. Par Verpillat. Paris, 1834. In 8vo.

<sup>8</sup> Op. cit., pp. 756 and 770.

23. Schindler<sup>1</sup> witnessed the death of a female from division of the epigastric artery, in an operation for femoral hernia.<sup>2</sup>

Notwithstanding that the records of many of the above cases are very imperfect, they are of considerable value in connection with the anatomy of the vessels before named; for, whilst it is proved, on the one hand, that large vessels have occasionally such relations to the neck of a crural hernia as seem to place them in the greatest danger from the incisions ordinarily made for the relief of the stricture of such a hernia, there can, on the other hand, be no doubt that such vessels have, on many occasions, been injured, and that fatal hemorrhage has resulted from operations performed with great care by very eminent surgeons. In these respects there is a remarkable difference between inguinal and femoral hernia; in the former, no vessel has been shown to have been injured in any single instance by the division of the stricture upwards when the part had been fairly exposed, nor has any vessel been seen in a position in which it could have been injured by such a proceeding; in the latter, the division of the stricture inwards, upwards, or outwards, has alike proved fatal from hemorrhage, and we have the best reasons for believing that such accidents will continue to recur, in a small proportion of cases, unless the possibility of arteries lying across the recognised lines of incision of the stricture be borne in mind, and the greatest care be exercised in all such operations. The necessity of accurate diagnosis is so apparent as to need little comment, for to mistake an inguinal for a femoral hernia, or the reverse, and to operate upon it with such a mistaken impression, must necessarily lead to death from hemorrhage in a considerable number of instances.

Lastly, in the instances in which a femoral hernia does not pass through the canal, but appears under some other part of the crural arch, and becomes strangulated, nothing but an accurate diagnosis of the position of the hernia, and a precise anatomical knowledge of the position and connections of the parts with which it must come into relation, can warrant a departure from the ordinary method of operating, and save the patient from the risk of fatal hemorrhage to which he would be subjected by the performance of the ordinary operation for femoral or inguinal hernia.

<sup>1</sup> H. T. Schindler. *Diss. de Herniis Observationes et Meletemata quædam*. Wittenberg, 1796.

<sup>2</sup> It is possible that all the cases referred to in Nos. 10, 17, 18, 19, 20, and 21, did not occur as individual instances, but that the same case, or cases, were observed and mentioned by several persons, though there is nothing to enable us to identify them. MM. Roche and Sanson state, that Dupuytren never wounded the epigastric artery; but we have the positive evidence of Dr A. Thomson, that that eminent surgeon wounded the epigastric on three occasions, whilst Dr Reid saw him divide the obturator directly across.

The conclusions which may be drawn from the foregoing considerations are the following:—

1st, In every possible variety of inguinal rupture, the stricture ought to be divided directly upwards, as by so doing there is not the slightest risk of hemorrhage.

2d, The probability of the occurrence of hemorrhage is much greater in operations for femoral than for inguinal hernia, as the epigastric, obturator, or internal circumflex artery may be divided in exposing the sac; and the obturator, epigastric, or a large anastomosing branch, may be injured in the division of the stricture.

3d, The varieties in the arteries named are sufficiently frequent to render them of great surgical importance, and that variety is most important in which the vessel is displaced inwards, by the descent of a femoral hernia, and becomes tensely stretched over the front and inner side of the neck of the sac.

4th, The risk of hemorrhage is not lessened by dividing the stricture of a femoral hernia in any other direction than inwards, or upwards and inwards, but it is very much diminished by dividing as few of the tense fibres of the edge of the ring as possible,—by avoiding a sawing motion,—and by pressing the edge of the knife rather upon the anterior surface than directly on the edge of the fibres constituting the stricture.

5th, In a male, whose testis has passed into the scrotum, the spermatic artery may be wounded, and the testicle lost, by dividing the stricture at the neck of the sac of a femoral hernia upwards, and, therefore, this method of operating ought to be relinquished.

